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ABSTRACT

To investigate whether student attitudes toward basic school subjects were multidimensional, responses of 876 students in grade 6 to a preliminary pool of 72 items from the Survey of School Attitudes (SSA) were factor analyzed. If attitudes are unidimensional, as suggested by the four scores yielded by the SSA (one each for reading/language arts, mathematics, science and social studies) then four factors should emerge by factor analysis. Nine additudinal factors emerged after first order analysis of the original 72 by 72 item intercorrelation matrix obtained with Harris-Kaiser Type II oblique rotation. These factors were: working with words in isolation; verbal communication (reading, writing, speaking; poetry; mathematics--spatial/geometrical; science--study; mechanics; studying differences; and civics--history. The same procedure was applied to second order analysis; four scores on factors emerged, corresponding to the four scores on the SSA, and to the common sense unidimensional notion of attitude structure. In conclusion, program evaluations should be sensitive to the multidimensional nature of attitudes. (CP)

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Some New Dimensions of Student Attitudes Toward Basic School Subjects

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Problem. Evaluations of educational programs in the basic skill areas frequently call for assessment of affective as well as cognitive outcomes, i.e. the effect of the program on attitudes toward as well as achievement in the domain. While some instruments are available for the measurement of such attitudinal variables, the methodology used in developing the instruments has been relatively primitive. In particular the lack of application of multivariate analyses in this area has been frequently lamented. In the absence of appropriate multivariate analysis or a guiding theory, measurement of attitude toward the basic skill areas has proceeded with the common-sense notion that there is one attitude toward reading, one attitude toward mathematics, etc. Essentially all of the currently available instruments for measuring attitude toward basic school subjects depend on this assumption. To what extent is the common-sense notion correct? Is there a single dimension which can be called attitude toward reading or is attitude toward reading (or mathematics, or science) multidimensional?

Method and Source of Data. The structure of student attitudes toward the basic school subjects was investigated using factor analytic methodology in a reanalysis of national data generated for the preliminary pool of items used in constructing the Survey of School Attitudes (SSA). The SSA, published by the Psychological Corporation, is one of the nationally available instruments which yields scores for attitudes towards the basic school subjects, with one score for Reading/Language Arts, one for Mathematics, one for Science, and one for Social Studies. If the structure of student attitudes towards basic school subjects follows the common-sense notion, as suggested by the scores yielded by the SSA, then exactly four factors should be identified by factor analysis.

The final version of the SSA contains 60 items (per level, per form) but the preliminary pool of items used in this study contained 72 items (per level, per form). The items were equally divided among the four school subject areas: Reading/Language Arts, Mathematics, Science, and Social Studies. Items were intended to represent various activities which students typically encounter in their work within each of the four curriculum areas. Each item was represented by a picture and a verbal description. For example, in the Mathematics area, one item showed a division problem accompanied by the words "Dividing numbers;" in the Social Studies area a picture of a map is accompanied by the words "Learning to use maps." Students responded to each item by indicating whether they "Like," "Dislike," or were "Not sure or con't Care" about each item.

Analyses were conducted for students in grade 6 in a national study of the SSA. A total of 876 students from 12 school systems, selected to be representative of the nation's schools in terms of geographic location, ethnic composition, and socioeconomic level, were included in the analyses.

A principal factor procedure was applied to the original 72 X 72 item-intercorrelation matrix with SMC's as communality estimates, followed by the Harris-Kaiser Type II (P'P Proportional) oblique rotation procedure. In order to investigate, second order factor structure, the factor intercorrelation matrix

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resulting from the oblique notation of the first order factors was analyzed using the same procedures as described above.

Results. The first order factor analysis resulted in the identification of nine attitudinal factors: three in the Language Arts area, two in Mathematics, three predominantly in the science area, and one in Social Studies. Within Language Arts, one factor dealt with verbal communication (including both reading and writing), a second dealt with poetry, and a third dealt with words in isolation (e.g. spelling, rhyming, syllabication, etc.). Within Mathematics, one factor dealt with the numerical aspects of mathematics (computation, numeration, etc.) while a second factor dealt with non-numerical aspects of mathematics (e.g. charts, graphs, geometry). Within science, one factor was defined by mechanical items (how things work, movements, gadgets, etc.); a second factor was defined by academic study of scientific topics; and a third factor was defined by items, partly from science and partly from social studies, related to analyzing differences (e.g. among plants, animals, or people). Differentiation along traditional content lines (biology, earth science, chemistry, etc.) did not occur. Social Studies was defined by a single factor labelled civics-history.

At a second order level, the nine factors converged in a predictable fashion, i.e. to confirm the traditional or common sense notion of the structure of attitudes. Four second order factors were identified: Language Arts, Mathematics, Science, and Social Studies, although the last of these was quite weak.

Implications. The results have important implications for instrument construction, program evaluation, and work with individual students.

The results indicate that more sophisticated methodology is needed in the construction of school attitude measures than has been used in the past if these measures are to accurately reflect the variables being investigated.

Program evaluations which include measurement of attitudes toward school subjects need to be sensitive to the multidimensional nature of these attitudes. For example, a program designed to affect "attitude toward mathematics" may have an impact on attitude toward the numerical aspects of mathematics but no impact (or even a negative impact) on the "other" attitude toward mathematics, vis. the non-numerical aspects.

Finally, teachers who are concerned with students' attitudes toward school subjects must become accustomed to thinking about those attitudes in terms of their underlying structure if teachers wish to effectively adapt instruction in light of student attitudes.

Analyses similar to those carried out in this study need to be conducted at both lower and higher grade levels in order to determine if the factor structure changes with grade level. Separate analyses by sex might also be helpful, particularly for the teacher's understanding of pupil differences.

DETAILS OF STUDY

Complete List of Items and Rationale for Scales. The particular instrument used in this investigation, the Survey of School Attitudes (SSA), was constructed to yield four scores (Reading/Language Arts, Mathematics, Science, and Social Studies), thus, implying, at least in a very general sense, that each of these curriculum areas can be represented by a unidimensional attitude. The scale for each area is based on items depicting school-related activities for the area. For example, mathematics items include "multiplying numbers," "working with (geometric) figures," "using a number line," etc. The complete list of items appearing in the version of the SSA used in this study is presented in Table 1.

Factor Analysis Method. The original 72 x 72 item intercorrelation matrix, with squared multiple correlations (SMC's) as communolity estimates was analyzed with a principal factor procedure to obtain a raw factor matrix. Based on preliminary runs and general considerations of the ratio of numbers of factors to number of variables, it seemed appropriate to extract factors to a limit of 10.

The intent of this investigation was to apply oblique factor analysis, i.e. to study relationships among factors and allow for the emergence of second order factors. The selection among various oblique rotation procedures is not, at present, a simple one. We have relied on the findings of Hakstian (1971) and Hakstian and Abell (1974) who found the Harris-Kaiser (1964) procedures generally preferable to other oblique rotational measures. Of the two Harris-Kaiser procedures, Type I (Independent Cluster) was found to have an "over-oblique" bias and preferable for factorially simple data whereas Type II (P'P Proportional) was found to have an "over-orthogonal" bias and preferable for factorially complex data. In practice, it was recommended that both procedures be used and the more interpretable result selected.

In the present study, the Harris-Kaiser Type II results are given for both first and second order analyses. The Type I analyses were also carried out and

found to yield results that were quite similar to Type II results in terms of interpretation of both first and second order factors, although the previously reported oblique and orthogonal biases of Type I and Type II procedures, respectively, were noted. An orthogonal (varimax) rotation was also employed; the results simply confirmed those of the orthogonal rotation reported in the SSA Manual.

All analyses were conducted on the Univac 1110 computer at the University of Wisconsin-Madison, using the Factor 3 and Rotate 1 programs in the STATJOB series.

Sample. Data for the analyses were taken from a national research program for SSA. A detailed description of the sample is given in the SSA manual Hogan,1975). The particular subgroup used in the present study were 876 students in grade 6 who took Form A of the SSA.

First Order Results. Table 2 presents the pattern loadings obtained for the Type 2 rotation. Table 3 presents item numbers (c.f. Table 1) and pattern loadings for loadings $\geq .30$ up to a maximum of 10 items per factor. Table 4 presents the intercorrelations among the factors. The following factors seem to emerge:

1. This is a mathematics factor, but it does not cover all aspects of mathematics. It covers all items dealing with computation, but also includes items relating to math concepts provided the concept deals with numbers. The factor can be labelled Mathematics - Numerical.

2. Items loading highly on this factor are also predominantly from the mathematics area, but from what we might call the nonnumerical aspects of mathematics. Included are items on measurement, geometry, charts, graphs, etc. Interestingly, items relating to maps, intended to be social studies items, also appear on this factor. The factor might be labelled Mathematics - Nonnumerical or, perhaps, Spatial or Geometrical.

3. Items loading highly on this factor come from the social studies area. Some parts of "social studies" will be represented on other factors, e.g. maps on factor 2, so it might be best to be more specific about this factor. Items in factor 3 seem to come from the subareas of civics and history. Thus, the factor might be labelled Civics-History.

4. This factor includes a rather strange mixture of items. However, four of the six items with highest loadings deal with words, in contexts where the words are being used in relative isolation, e.g. spelling or rhyming. We might label the factor Working with Words

5. This factor includes primarily items from the science domain, where the emphasis is primarily on studying about various science topics. This factor, which might be labelled Science - Study, contrasts interestingly with factors 7 and 8 described below.

6. This factor includes most of the items that deal with verbal communication and may be labelled thusly. It is worth noting that reading, speaking, and writing all seem to come together in this factor.

7. This factor is an exceptionally interesting one. It seems to combine items from different subject areas, provided that the items deal with differences. It will be noted that three of the four items with loadings above .30 contain the word "different" and the fourth item (18) depicts four different geometric shapes. The factor might be labelled Studying Differences or Analytical Interest. Is it possible that there might also be a Synthetic Interest for children, which did not emerge simply because there were no items representing it in this particular item pool?

8. This factor might be labelled Science: Mechanics or Mechanical Interests. Items deal primarily with how things work, gadgets, and other mechanical matters, extending even into the social realm: Note the wording of the one social science item here - "how the courts and judges work."

9. This factor is clearly limited to Poetry, both reading it and listening to it and, presumably, doing anything else with it. Hence, at least to children, poetry is seen as falling into a category other than verbal communication as defined by factor 6.

10. This last factor is perhaps not worth interpreting, as it is obviously very weak. Both items with loadings above .30 deal with words in isolation, as defined by factor 4 and item 16 has about equal loadings on factors 4 and 10.

Second Order Factors. Table 4 presents the intercorrelation matrix for the 10 factors identified in the first order analysis. This correlation matrix was analyzed by the Type 2 procedure, the resulting factor matrix of pattern loadings being shown in Table 5 and the correlation matrix for the second order factors appearing in Table 6. The second order factors appear to be as follows:

1. This is clearly a general Mathematics factor, combining the Numerical and Nonnumerical factors identified at the first order level.

2. This is clearly a Verbal or Language Arts factor, combining the Working with Words (4), Verbal Communication (6) and Poetry (9) factors from the first order level.

3. This factor appears to be a Science factor, combining Science - Study (5), Studying Differences (7), and Mechanics (8) from the first order level.

4. This factor corresponds to the Civics-History factor at the first order level and does not combine with any other first order factors.

Figure 1 provides a convenient overall summary of the dimensions of students' attitudes toward basic school subjects found in this study. This framework might suggest directions for further scale development and for the investigation of relationships between these factors and other variables, such as attitude toward school in general, self-concept, achievement in particular school subjects, etc.

It would also be interesting to investigate possible changes in this structure across age groups.

First Order Factors	Second Order Factors
Mathematics - Numerical	Mathematics
Mathematics - Nonnumerical (Spatial, Geometrical)	
Wording with Wrods (in isolation)	Language Arts
Verbal Communication (Reading, Writing, Speaking)	
Poetry	
Science - Study	Science
Mechanics	
Studying Differences	
Civics-History	Social Studies

FIGURE 1. Summary of First and Second Order Factors

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Table 1. Item Stems for 72 Interest Items used for Factor Analysis

1	M	...what numbers mean[a]	37	M	Dividing numbers
2	SS	...cities	38	SS	...weather in different places
3	S	Seeing how plants grow	39	S	...different kinds of trees
4	R	Writing letters to friends	40	R	Learning to spell
5	SS	Looking at writings done long ago	41	SS	...how many cars made in diff. years
6	M	Adding numbers	42	M	Solving world problems
7	R	Reading to the class	43	R	Using the encyclopedia
8	S	...the stars	44	S	...what causes pollution
9	M	Telling which number comes next	45	M	...different kinds of numbers
10	SS	...the President's job	46	SS	...how courts and judges work
11	S	...what different animals eat	47	S	...things that live in the water
12	R	...parts of words	48	R	Getting a book as a gift
13	M	Multiplying big numbers	49	M	...fractions
14	SS	...our country	50	SS	...what taxes pay for
15	S	...different parts of the body	51	S	...solids, liquids, and gases
16	R	Making words that sound alike	52	R	Reading poems
17	SS	...how different people live	53	SS	...different groups of people
18	M	Working with shapes	54	M	...weights
19	R	Reading stories	55	R	Using the dictionary
20	S	...how motors work	56	S	...why some things float
21	M	Finding the missing number	57	M	Multiplying...in different ways
22	SS	...parts of a city from a map	58	SS	...famous people
23	S	Working with magnets	59	S	...insects
24	R	Finding words that mean the same	60	R	Making up a title for a story
25	M	Doing hard subtracting problems	61	M	Using a number line
26	SS	...new methods of farming	62	SS	...how to use charts
27	S	...how propellers move ships	63	S	...how the heart works
28	R	Reading books about history	64	R	Going to the library
29	SS	...different ways to travel	65	SS	...different kinds of buildings
30	M	...when to use these signs(<,>,=)	66	M	Working with sets
31	R	Listening to poems	67	R	Choosing a good word for a sentence
32	S	...what causes storms	68	S	...different groups of foods
33	M	Measuring things	69	M	Constructing graphs
34	SS	...high mountains	70	SS	Using maps
35	S	...rock formations under ground	71	S	Measuring how fast things go
36	R	Telling stories to the class	72	R	Writing reports for school

[a]Ellipsis at beginning of item stem indicates omission of wording such as learning about, studying about, finding out about.

Table 2. First Order Factor Matrix (Pattern Loadings) Obtained with Harris-Kaiser Type 2 Oblique Rotation[a]

ITEM/FACTOR	1	2	3	4	5	6	7	8	9	10
1	392	159	089	080	146	-040	-051	-012	057	069
2	076	079	378	144	-036	-012	093	155	039	-067
3	-007	-051	024	060	238	092	270	-070	139	019
4	083	-101	024	204	-112	243	021	-003	084	074
5	-006	-066	259	073	170	-021	068	049	036	156
6	595	037	-086	081	035	-013	023	-061	-049	025
7	157	-062	-029	000	-130	491	031	079	094	023
8	-113	049	264	-143	384	055	133	085	090	068
9	378	227	-042	-039	034	037	079	-012	-005	169
10	108	055	361	003	-121	090	079	164	047	048
11	090	-131	-039	203	107	052	435	024	-022	-060
12	228	-002	253	177	-038	088	079	-023	-005	348
13	650	064	053	-025	135	038	-090	023	-022	-064
14	005	009	624	109	047	-052	043	022	075	011
15	000	047	122	048	434	-052	097	052	107	028
16	119	-039	004	326	-068	102	133	-031	019	364
17	140	-091	301	153	-042	-070	337	115	048	-081
18	005	222	-009	-025	-024	151	339	-213	025	244
19	044	-066	239	-034	-004	472	-002	-178	028	050
20	-041	182	078	-153	362	-110	-048	329	-209	110
21	656	083	-064	-070	054	078	072	027	026	071
22	029	344	299	022	-058	-001	140	065	-019	-013
23	-150	173	-112	-007	123	021	212	092	051	189
24	256	-038	133	277	-072	172	084	-044	-014	237
25	632	044	033	-040	151	012	-066	-054	031	-045
26	086	027	131	-116	201	047	260	255	-079	052
27	-001	119	114	-133	318	078	087	350	-138	223
28	094	039	559	-052	029	167	020	-029	134	-044
29	032	139	092	253	-111	008	257	267	-152	066
30	499	103	018	079	093	-027	050	-038	070	201
31	020	035	-126	067	004	009	049	151	662	183
32	-042	133	098	248	277	-034	189	011	030	-017
33	011	377	-051	009	069	152	198	-189	-040	159
34	-025	113	263	019	179	058	245	110	-051	-105
35	-004	111	208	004	431	027	092	052	005	-037
36	131	005	-144	-002	-131	538	027	204	183	-040

[a]Decimal Points omitted.

Table 2. (Continued)

ITEM/FACTOR	1	2	3	4	5	6	7	8	9	10
37	623	051	006	049	138	071	-059	-061	039	-024
38	037	119	081	301	113	-006	295	077	058	-119
39	057	045	019	049	185	181	452	030	071	-123
40	233	-068	070	397	029	089	-007	-050	072	203
41	-002	253	017	026	140	018	010	435	-139	104
42	410	300	010	-014	056	142	-031	-044	-029	050
43	013	153	282	217	096	184	-101	-028	122	-089
44	-063	122	133	361	140	090	-040	147	-053	019
45	487	318	067	056	064	-080	-048	-035	062	143
46	-011	214	134	046	-053	174	019	300	078	003
47	-036	080	-008	123	320	080	213	109	024	-152
48	-033	009	091	145	034	488	-068	-086	132	-055
49	480	277	001	043	133	-026	-054	-143	093	072
50	118	309	176	188	054	025	-106	161	-005	-010
51	-075	276	057	182	348	098	052	016	-024	058
52	057	002	-126	183	-068	058	035	143	666	107
53	149	-047	256	284	-087	030	181	148	102	-135
54	185	393	065	113	185	-020	001	011	-006	088
55	184	160	075	331	063	128	-190	008	097	-040
56	-076	213	-036	340	215	048	124	015	-003	081
57	652	102	046	083	104	021	-125	-013	039	-001
58	-007	033	560	107	049	065	-035	046	107	-013
59	-109	069	000	059	431	128	146	13.	037	-067
60	-013	045	-025	221	028	336	030	060	128	-002
61	321	450	-041	033	-024	-031	-017	-044	140	061
62	092	620	143	064	-026	-016	072	-062	003	-063
63	049	067	041	188	486	-034	054	077	061	-081
64	-134	049	105	308	070	347	-015	-167	053	-070
65	-032	152	216	301	-054	045	103	300	-055	-147
66	438	321	-052	085	032	007	039	-111	113	006
67	202	-064	-017	465	051	105	-024	-024	106	105
68	082	082	-011	276	061	177	201	115	-044	-034
69	103	628	012	-036	-120	071	056	048	014	-067
70	043	389	329	-102	058	144	059	045	054	-157
71	-000	257	010	034	236	-044	-094	380	-167	083
72	137	029	168	141	020	320	-117	-017	104	019

Table 3. Interest Items with Highest Loadings on Ten Factors Obtained with Harris-Kaiser Oblique Type II Rotation

Factor:	1		2		3		4		5		6		7		8		9		10	
	I[a]	L[b]	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L
	21	66	69	63	14	62	67	46	63	49	36	54	39	45	41	44	52	67	16	36
	57	65	62	62	58	56	40	40	15	43	7	49	11	44	71	38	31	66	12	35
	13	65	61	45	28	56	44	36	59	43	48	49	18	34	27	35				
	25	63	54	39	2	38	56	34	35	43	19	47	17	34	20	33				
	37	62	70	39	10	36	55	33	8	38	64	35			65	30				
	6	60	33	38	70	33	16	33	20	36	60	34			46	30				
	30	50	22	34	17	30	64	31	51	35	72	32								
	45	49	66	32			65	30	47	32										
	49	48	45	32			38	30	27	32										
	66	44	50	31																

a: I = Item number (from *Table 1*)

b: L = Loading, decimal points omitted. Only items with loadings ≥ \|30\| reported up to a maximum of 10 items per factor.

Table 4. Correlation Matrix for First Order Factors (Decimal points ommitted)

Var.	1	2	3	4	5	6	7	8	9	10
1	1000									
2	355	1000								
3	111	253	1000							
4	224	197	287	1000						
5	136	320	237	183	1000					
6	157	134	218	357	046	1000				
7	-012	173	218	274	297	173	1000			
8	-079	209	243	135	290	034	225	1000		
9	178	044	070	283	-009	307	076	-050	1000	
10	239	122	-046	148	060	068	073	003	106	1000

Table 5. Rotated Factor Matrix (Pattern Loadings) for Second Order Factors Obtained with Harris-Kaiser Type 2 Oblique Rotation

Var./ Factor	1	2	3	4
1	552	168	-157	-081
2	538	-028	093	123
3	156	167	169	323
4	155	450	237	032
5	302	-124	361	100
6	046	510	069	076
7	028	108	465	029
8	067	-122	378	183
9	040	476	-001	-075
10	265	080	097	-283

Table 6. Correlation Matrix for Second Order Factors (Decimal points ommitted)

Var.	1	2	3	4
1	1000			
2	243	1000		
3	233	153	1000	
4	098	-000	453	1000